The role of knowledge in large Australian city – Regions: A traditional industry in Greater Western Sydney and the Hunter Region

Authored by:
Cristina Martinez
Merete Bjørkli

Australian Expert Group in Industry Studies,
University of Western Sydney

c.martinez@uws.edu.au
m.bjorkli@uws.edu.au
1. INTRODUCTION

This paper discusses the role and effects of regional knowledge systems on traditional industries, specifically the steel industry in the regions of Greater Western Sydney and the Hunter.

There have been two major approaches to industry innovation both at the national and regional level. One approach takes the view that clusters and networks are the way to build new industries (Breschi & Lissoni, 2001; Capello, 1991). The positive role played by universities in assisting such transformation seems to be related to their geographical proximity with the firms in question (Breschi & Lissoni, 2001). As Maskell & Malberg (1999:181) have pointed out, knowledge creation is embedded in a region’s distinct institutional endowment, so a firm’s competitiveness is not isolated from regional capabilities in terms of knowledge creation.

Another approach acknowledges that major manufacturing regions in industrial countries experienced crises during the 1970s (Zook, 1997) largely caused by technological innovation and the globalisation of markets and distribution systems as well as the oil crisis. These industries nonetheless remain critical to the economic development of most OECD countries, including Australia (OECD, 1993, 1996, 1997, 1999). All these countries are seeking to renew the traditional industries dominant in many regions. More specifically, they are seeking to assist their transformation through the creation and use of new knowledge.

This paper explores the effects of territorial systems on the knowledge and innovation processes of industries traditionally regarded as low-knowledge intensive, in this case the steel industry. The two regions chosen, The Hunter and Greater Western Sydney, both have a regional university, TAFE and other knowledge institutions from where transfer of innovation can be analysed as a potential core element of their territorial innovation system.
The significance of this type of study lies in improving the theoretical and policy related understanding of the role of regional systems in specific knowledge creation and use by traditional industries. Old industries territories are often regarded as part of the new knowledge economy and this paper looks into the regional system where the traditional firm is embedded to identity the intersecting factors affecting the creation and use of knowledge for and within the firm. Although no claims can be made outside the contours of the case study and related regions, the study might be representative of the Australian steel industry as there are only three steel companies in Australia.

The rest of the paper is structured in three sections. First is presented the knowledge systems in the Hunter and Greater Western Sydney (GWS) regions. Second is presented a section about knowledge and traditional industries with some background on the case of the steel industry in Australia. Finally is a discussion about the interactions of an Australian steel company with the knowledge systems in Hunter and GWS.

2. REGIONAL KNOWLEDGE SYSTEMS IN THE HUNTER AND THE GREATER WESTERN SYDNEY REGIONS

The transformation of the so-called low tech industries to meet new conditions has never been a major focus of attention in Australia despite the fact that Australia’s economy is still considerably dependent in resource based industries. Innovation in any industry requires the generation and use of new knowledge. New knowledge can be acquired internally (in-house capabilities), externally (R&D organizations, training and KIBs), and through regional networks (applied regional knowledge and information). Regional networks generate ‘network capital’, a concept defined here as the capacity of a region to activate all socio economic actors in a way that accumulates processes of collaboration and innovation in the transformation of its industries (Sik, 1994; Wong, 1998, Martinez-Fernandez, 2001).

Previous work by Martinez-Fernandez shows the role and effects of regional networks in renewal of old industry territories in Australia and Spain (Martinez Fernandez, 2001). Regional networks include organisations from the public, private and civic sector as they operate around projects of regional development. The result from that study shows that regional networks greatly assist innovation through
sharing information and knowledge and participating in specific projects. Specifically, the study found that frequency of communication among regional organisations and institutions is a structural element that significantly affects the creation and use of knowledge to produce new projects, and that geographic proximity plays a significant role in the innovation process. These results are also online with recent research by Acs (2002) pointing out that local systems of innovation rely more on the knowledge economy as knowledge has increased the importance of geographic proximity, and empirical evidence suggests that location and proximity clearly matter in exploiting knowledge spillovers.

According to Nauwelaers & Reids a regional innovation system is the set of economic, political and institutional relationships occurring in a given geographic area which generates a collective learning process leading to rapid diffusion of knowledge and best practice (Nauwelaers & Reid 1995). The paradox remain in that knowledge can be transferred, produced and diffused also through global networks which are only partly dependent on proximity. The more global knowledge economies become the less dependent they are on national institutions yet, despite this, spatial proximity seems to retain importance (AEGIS, 2003, Audretch 1995). According to a study carried out at AEGIS in 2002, much knowledge is ‘sticky’ and does not travel far. It is therefore very important for firms to maximise their information about the local knowledge institutions in the region where they are located (AEGIS, 2002).

The literature is increasingly acknowledging the importance for regions to optimise the values of public sector knowledge institution. (OECD 1999, Maskell 2001, Acs 2002). A region’s competitiveness is dependent on how to acquire knowledge capital and how to apply new knowledge through a highly trained workforce. The recent AEGIS study (2003), for instance, remarks that the key to success is creating and improving links between knowledge producers and knowledge users,

'Spatial proximity to the sources of new knowledge does not automatically encourage firms to take advantage of what is on offer. This means that special measures may be needed to diffuse information, skills and technologies more effectively in the local region rather than simply rely on ‘simple’ commercialization plans which do not take account of the locations of potential users. Spatial proximity between knowledge generating and using organizations will not be enough to ensure that maximum use is made of available information’. (AEGIS, 2003:8)

'Since few areas are likely to be self sufficient in knowledge generation and use, it is also important to see how both firms and knowledge organizations firms gather and use information drawn from multiple sources. This will also reveal gaps where firms, for instance, would prefer to work more closely with local organizations but find that the relevant knowledge and skills are not available'. (AEGIS, 2003:9)
‘Overseas experience and the international literature on innovation suggest the importance of policies to encourage collaboration between knowledge organisations and the associated knowledge creation and better development and diffusion of innovation’. (AEGIS, 2003:72)

Specifically about the role of knowledge systems Acs (2002) discusses the meaning of ‘local’ systems of innovation as an alternative hypothesis to National Innovation Systems. The position between local national systems of innovation is rooted in the contrast between two dynamics: the bottom-up dynamics of networks and the top-down dynamics built on the centralised mindset. Networks are associated with voluntary adherence to norms and building of consensus. Networks generate wealth and social capital but also a higher degree of innovativeness and capacity to transform because networks cross boundaries. Acs stresses that despite increased evidence of the ‘local’ systems of innovation, the centralised ‘national system of innovation’ continues to dominate the policy scene, and the view of fragmented and localised sets of systems of innovation is yet to gain currency. This section will now present two regional knowledge/innovation systems in the GWS and in the Hunter.

2.1 Greater Western Sydney (GWS) Knowledge System

A regional innovation system can be composed of knowledge institutions such as universities, TAFE, CSIROs, CRCs, airports, teaching hospitals, Government organisations, not-for-profit organisations, research organisations and enterprises.

In GWS there are two main knowledge institutions; University of Western Sydney (UWS) and TAFE. There are no CSIRO or CRC’s located in GWS, however UWS is a core participant in three CRC’s located in Brisbane and UNSW.

The University of Western Sydney has six campuses spread across the Greater Western Sydney: Hawkesbury, Blacktown, Parramatta, Bankstown, Campbelltown and Penrith.

There are the following teaching hospitals associated to Sydney Uni, UNSW and UWS:

- Westmead Hospital: Teaching hospital, Sydney University, UWS;
- Nepean Hospital, Teaching Hospital, Sydney University, UWS;
- Bankstown Hospital: teaching hospital for UNSW;
- Liverpool Hospital, teaching hospital for UNSW, research links to UWS;
- Blacktown, Mt Druitt, Auburn and Hawkesbury are smaller hospitals which participate in teaching.
TAFE has three Institutes in the region with 17 campuses administered through the Western Sydney Institute (8), Southern Sydney Institute (3), and South Western Sydney Institute (6).

Other organisations part of the regional system are a small airport located in Bankstown with links to the aviation department at UWS Bankstown campus; 23 regional organisations in GWS from the public, private and civic sector and 20 research companies. Figure 1 below show the Greater Western Sydney Knowledge organisations clustering around the boundaries with Auburn and Parramatta.
Figure 1: Map of Greater Western Sydney and it’s Knowledge Institutions

Note: government departments, regional organisations and the airport are not included in the map.
2.2 Hunter Region Knowledge System

In the Hunter region there are two main knowledge institutions: University of Newcastle and TAFE. There is one CSIRO, but no CRC’s located in the Hunter region. The University of Newcastle is however a core participant in six CRC’s located in other regions.

CSIRO has recently opened a new Energy Centre in Newcastle. There are no CRC’s located in the Hunter region, but University of Newcastle is a core participant of seven CRC’s located in Victoria, WA, Canberra and Queensland. TAFE Hunter Institute has sixteen campuses. There are ten Hospitals in the Hunter region. Three of these are teaching hospitals; ‘John Hunter’, ‘Newcastle Mater’ and ‘Royal Newcastle’.

There is also a major regional airport in Wellington, 11 research companies, and 36 regional organisations. These organisations constitute a ‘regional network’ with strong links among the private, public, and civic sector. Its influence on regional planning and regional innovation in the form of new projects of economic development is significant for the region (Martinez-Fernandez, 2001).
Figure 2 below shows the knowledge institutions in the Hunter, most of them clustering around Newcastle City.

Note: public institutions and regional organisations are not included in the map.
The role of knowledge in large Australian city regions

The maps above show the clustering of organisations around the city of Newcastle and the city of Parramata (third economic centre of Sydney) and a drought of organisations in the more rural areas. The reasons are found in the population and industry concentration but also in lifestyle choice of specialised labor and the presence of Universities as magnets of talent.

We have focused in the next section on the transmission, generation and transfer of knowledge as important functions within a knowledge system as recent research indicates the critical contribution of knowledge to regional grow (Acs 2002, AEGIS 2003, Martinez & Davison, 2003). Acs argues that at the core of the ‘new’ growth theory is the concept of technological knowledge as a non-rival, partially excludable good, as opposed to the neoclassical view of knowledge as an entirely public good. Acs differentiates between ‘knowledge’ and ‘technology’. Knowledge is a non-rival good because it can be used by one agent without limiting its use by others. Technology in many cases is partially excludable because it is possible to prevent its use by others with legal methods such as patents and commercial secrecy. However, no method can put boundaries to such a thing as information so it can be suggested that industrial R&D may generate technical spillovers via mobility of highly skilled personnel between firms, and by interactions among actors in an innovation system bounded by geographic proximity.

Acs argues that there is a direct link between knowledge institutions spillovers and regional growth. The implications of knowledge spillovers being positively impacted by ‘proximity’ might mean that new producing inputs are not evenly distributed across space and so regions might not grow at the same rate. Theoretically this implies that geography might be a relevant unit of observation of knowledge spillovers. In addition there are important implications for entrepreneurship as available information and knowledge is the basis for recognising ‘opportunities’ that can be profitably exploited. Thus, those regions with more ‘available knowledge’ might present more opportunities to be pursued by entrepreneurs than regions where ‘knowledge’ is not produced or available (Acs 2002).
2.3 Knowledge transmission, generation and transfer

Knowledge systems can have three functions in a region: transmission of knowledge, generation of knowledge and transfer and adaptation of knowledge. This section looks at some indicators of each of them for the regions of study. GWS is the third largest regional economy in Australia after Sydney and Melbourne. The figures for the Hunter need to be read with that in mind.

**Knowledge Transmission**

An indicator of knowledge transmission is the number of students enrolled in the main knowledge institutions. Figures 3, 4 and 5 below show the number of TAFE and University students in GWS and Hunter.

**Figure 3: TAFE Enrolments in Greater Western Sydney**

![Figure 3: TAFE Enrolments in Greater Western Sydney](image)


Figure 4 shows the number of TAFE students in the Hunter.

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1 * We have included the following Colleges:

1) All the campuses of Western Sydney Institute, a total of 50,208

2) We have included the following Colleges at the Southern Sydney Institute: Bankstown (2200), Lidcombe (2141), Padstow (2211),

3) We have included the following Institutes from South Western Sydney Institute: Campbelltown (2560), Granville(2142), Liverpool (2170), Macquarie Fields (2564), Miller (2168), Wetherill Park 2164 and SWSI International
Figure 4: TAFE Enrolments in the Hunter Region in 2000, 2001 and 2003.


Differences in number of tertiary education enrolments are also noted in Figure 5.

Figure 5: Students Enrolled in Universities by Institution in the Hunter Region and Greater Western Sydney in 2001

Source: Commonwealth Department of Education, Science and Training, 2002, Table 29

Traditionally the effects of universities in the local/regional economy has been on the pool of trained and highly qualified science and engineering graduates that may provide a supply of labor to local firms or else a supply of entrepreneurs for new start-ups in the high technology sector (Acs, 2002). The next figure shows the number of specialised graduates in these fields in both regions.
Figure 6: All Students by Institution in the Hunter Region and Greater Western Sydney and Broad Field of Education, 2001

Source: Commonwealth Department of Education, Science and Training, 2002, Table 32

Figure 7 shows the detail of students enrolled in engineering and related technologies in both regions. Engineering degrees will be the most relevant to the steel industry. The figure shows the bigger pool of engineering students in Newcastle, which might indicate a field of regional specialisation under the influence of the steel industry and BHP operations in Newcastle since 1915.

Figure 7: Engineering and Related Technologies

Source: Commonwealth Department of Education, Science and Training, 2002, Table 32

Knowledge Generation and Transfer

We look at generation and transfer of knowledge together because spillovers might occur immediately during the generation of knowledge and it is not clear that both functions can be separated. The available data here is the expenditure on R&D, some data related to patenting and licensing, and the number of postgraduate
students by research field in each region. Here we present only the expenditure on R&D. Figure 8 below show the higher expenditure in general by the University of Newcastle. The difference is significant in terms of engineering and technology - Newcastle Uni is expending much more than UWS as this field of expertise provides the knowledge base of the steel industry.

Figure 8: Expenditure on R&D by Institution and Broad Field of Study, 2000

Source: Expenditure on R&D by Institution in NSW and Broad Field of Study, 2000 (Commonwealth Department of Education, Science and Training, 2000, Table 3)

It is widely accepted today that much knowledge is generated by industry. Figure 10 shows the different research expenditure between the higher education sector and industry. Applied research is the area where both worlds converge, while experimental development is strongly driven by industry.
The figure above might lead to the interpretation that 'industry' is in fact leading knowledge generation and innovation as per its expenditure in applied and experimental research. The conventional view here has also been that large enterprises drive the agenda of innovations as per their dedicated R&D departments. However, recent empirical research found different evidences (Acs, 2002). Acs uses a large US innovation database to test whether university research labs were important for firm innovation. He found evidence that small firms take greater advantage of knowledge spillovers from universities than large firms, for whom corporate R&D is a more important source of generating and commercialising innovation. Acs found that geographic proximity between universities and corporate laboratories clearly serve as a catalyst to innovative activity for firms of all sizes but especially for small firms.

We know very little about how knowledge is transferred between university-industry or vice versa and we know even less about the impact of the transfer of knowledge on innovation. Specifically regarding the role of universities as engines of growth the literature evidences that innovative activity increases as a result of research undertaken by universities within the geographical proximity (Acs, 2002). Acs uses...
data for 43 US states and for 125 metropolitan statistical areas (MSAs) to look at the local geographic effects that university research may have on the innovative capacity in a region. The results of his statistical analysis suggest that the spatial range of interaction between private R&D and university research reaches beyond the county (or MSA) where the R&D is carried out. There is no evidence that private R&D in the MSA or its surrounding counties is endogeneous to the university research equation. By contrast, there is a strong indication that university research in an MSA is endogeneous in the private R&D equation. In fact, local university spillovers are specific to certain industries. In the database examined by Acs, there were not spillovers in the drugs and chemicals and in the machinery sectors but very strong and significant spillovers are evidenced in the electronics and the instruments industries. These spillovers extend the boundary of the MSA within 75-mile range from the central city. Acs argues that his findings suggest that regional institutions – universities, research laboratories, specialised business services, related industries and entrepreneurship - are key ingredients in promoting regional growth.

We next discuss how a traditional Australian steel company interacts with the knowledge systems of GWS and the Hunter.

3. THE ROLE OF KNOWLEDGE IN TRADITIONAL INDUSTRIES

Traditional industries have had to restructure themselves around knowledge and their transformation is a key part of a modern economy characterised by product service linkages. There seems to have been a conception that traditional/old industries and service industry, are separate areas of economic activity, but according to a study carried out by AEGIS (2002), the two economies are often not really separate at all. Instead of talking about new and old economies, the study suggests it is more useful for companies to restructure the corporate strategy and link manufacturing and services. The literature in this aspect concludes that innovation exists in all industrial sectors, not only in the high tech sector (Maskell 2001, Smith 1999, Marceau & Martinez 2002).

The company analysed in the case study will be referred to as company X.

Although the AEGIS study proposes an interesting argument, that manufacturing firms should use product-service packages instead of separate products or services, the reality of how enterprises work is not the same for SMEs as it is for large
companies. For example, company X was created to combine eight diverse yet related businesses to form an integrated mining, steel manufacturing, and steel and metal products distribution company. Even within this explicit integrative strategy, the four business units of company X have different strategies, internal developments and few interactions between the different business units. The different business models are best seen when comparing market mills with distribution. Distribution is a business unit that requires many more contacts with clients as a large part of its operation, it is client focused and driven. Thus, this unit is more ‘service’ oriented and has more links with regional organisations than the market mills unit. For large organisations it is often not appropriate to have all business units oriented to services, it might make better sense to have just one business unit more closely linked to clients while the others focus on their more production/manufacturing activities (AEGIS interview data, 24.09.03).

Both ‘new’ and ‘old’ industries require knowledge to be competitive, but according to a survey conducted by the Australian Industry group (AIG) in 2002 only four percent of Australian manufacturing companies undertake R&D (AIG, 2002:8). The study further shows that only 24 percent of the manufacturing firms, which are undertaking R&D activity, had collaborated with a public R&D facility such as a university, CSIRO or CRC. This percentage is however increasing with company size (AIG, 2002:10). The AIG study also shows that most manufacturers are self-funded regarding R&D. According to the study government grants and tax concession accounts for only 2.5-3 percent of the expenditure (AIG, 2002: 9).

Traditional industries may seem to be low tech, but they are also part of high tech systems. So even though many manufacturing companies do not spend much money on R&D, knowledge will flow into the companies through other mechanism such as the ‘embodied’ and ‘disembodied’ knowledge flows pointed out by Smith (1999):

‘Embodied flows’ which involve knowledge built into machinery and equipment. ‘Disembodied flows’ which involve the use of knowledge, transmitted through scientific and technical literature, consultancy, education systems, movement of personnel and so on. (Smith, 1999:9)

Smith argues that knowledge indirectly gets transported into traditional industries, through technical equipment, scientific and technical literature, education system, consultancy and through movement of other personnel. He also argues that
knowledge is not therefore linked to their direct performance. It is more the indirect link with universities, research institutes and supplier companies.

‘Most so called low tech sectors are intensive in their use of scientific knowledge such as food production, machinery, printing and publishing, wood products and a range of services, have significant indirect science inputs. The depth and complexity of industry knowledge bases are not linked to their direct R&D performance’…‘These science inputs are supported by complex, indirect links with universities, research institutes and supplier companies. Thus low tech industries are frequently part of high tech systems and policy makers should be aware of their significance for growth…growth is not primarily based on the creation of new sectors but on the internal transformation of sectors which already exists. This internal transformative capacity rests in turn on complex innovative systems which create distribute and maintain advanced knowledge’. (Smith, 1999; 21)

To further test the argument of Smith we examined a traditional industry searching for the elements of knowledge acquisition through their interaction with the regional knowledge systems in the two study regions. This analysis is presented below in section 4. First is presented some background in the steel industry

3.1 The case of the Steel Industry

Background
The Australian steel industry has, during the last few years, undergone restructuring and rationalization to reduce cost and improve efficiency. Today the industry is seen as modern and competitive and receives no government subsidies. This has been achieved by closure of less competitive branches such as the loss making Newcastle steel mill in 1999. In 2001, Australia produced 0.8 percent of the world’s steel and ranked number 22 in the world’s steel production (Faber, 2002:6). Today the Australian Steel Industry consists of three major steel companies: Smorgon Steel Group (which listed at the Australian Stock Exchange in February 1999). OneSteel Limited (listed at the Australian Stock Exchange the 23 of October 2000, as a spin-off company from BHP Limited).2 BlueScope Steel (previously BHP Steel Limited) listed on the ASX the 15 of July 2002. The company was previously a business group

2 http://www.onesteel.com/news.asp?newsID=21 “OneSteel Limited (ASX: OST) is Australia's largest manufacturer and distributor of structural, rail, rod, merchant bar, reinforcing, wire, tube and pipeline steel products. OneSteel comprises OneSteel Whyalla Steelworks, OneSteel Market Mills, OneSteel Distribution and a 50.1% holding in Steel & Tube Holdings (NZ) – a total value-chain – from mining to steelmaking, through manufacturing to distribution. OneSteel has an annual turnover of $3 billion, over 30,000 customers, hundreds of sites across Australia, as well as in New Zealand and Canada and around 7,000 employees”.
within BHP Billiton. Figure 10 below shows the three companies operation sites in Australia.

Figure 10: Australian Steel Mills

Employment Figures and Turnover of the Australian Steel Industry

If we define the steel industry in narrow terms (ANZSIC 2711, basic iron and steel manufacturing) there were 19,100 people working in the steel industry in 2000/2001, with an annual turnover of AU$8.1 billion. If we however, look at the steel industry in broader terms and include all the industries listed in Table 1 below, there are 75,100 people employed, with an annual turnover of A$21.1 billion. The numbers have been halved where the ANZSIC classes do not distinguish between the Iron and Steel Industry and the Steel Industry (Faber, 2002).
Table 1: Industry Classes Related to the Australian Steel Industry, 2000-2001

<table>
<thead>
<tr>
<th>ANZSIC</th>
<th>Industry Class</th>
<th>Employment thousands</th>
<th>Turnover A$ billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>2711</td>
<td>Basic iron &amp; steel manufacturing</td>
<td>19.1</td>
<td>8.1</td>
</tr>
<tr>
<td>2712</td>
<td>Iron &amp; steel casting &amp; forging</td>
<td>5.3</td>
<td>1.0</td>
</tr>
<tr>
<td>2713</td>
<td>Steel pipe &amp; tube</td>
<td>4.1</td>
<td>1.2</td>
</tr>
<tr>
<td>2741</td>
<td>Structural steel fabricating</td>
<td>17.3</td>
<td>2.9</td>
</tr>
<tr>
<td>275</td>
<td>Sheet metal product manufacturing</td>
<td>18.2</td>
<td>3.2</td>
</tr>
<tr>
<td>276</td>
<td>Fabricated metal product Manufacturing</td>
<td>40.4</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>Iron and steel wholesaling</td>
<td>Na</td>
<td>3.3a</td>
</tr>
<tr>
<td></td>
<td>Total (only half of 275 and 276 included)</td>
<td>75.1</td>
<td>21.1</td>
</tr>
</tbody>
</table>

Source: Extracted from the Department of Industry, Tourism and Resources Web Page http://www.industry.gov.au/content/controlfiles/display_details.cfm?ObjectID=99BC02FC-7257-4640-A9DB437A54CA729A
ABS annual publication 8221.0 and predecessor publications deflated using GDP implicit price deflators supplied by the ABS. Data interpolated for 1970-71 and 1985-86.

Note: the ABS changed its manufacturing survey from one based on manufacturing establishments to one based on manufacturing management units in 2000-2001. The original table is from Faber, The Australian Steel Industry, p 5.

Basic iron and steel-manufacturing turnover in Australia over 30 years has been very stable, much the same as it was thirty years ago. Table 2 outlines the earnings and turnover ratio for the three Australian steel companies in 2000/2001 and 2001/2002.

Table 2: Sales Revenue in the Three Steel Companies

<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>OneSteel Limited</td>
<td>2,959.1m</td>
<td>2,637.7 m</td>
<td>2,906 m</td>
</tr>
<tr>
<td>Smorgon Steel</td>
<td>2,267 m</td>
<td>2,441.4 m</td>
<td>2,666.2 m</td>
</tr>
<tr>
<td>BlueScope Limited</td>
<td>Not available</td>
<td>4,941 m</td>
<td>4,593 m</td>
</tr>
</tbody>
</table>

Smorgon Steel, Annual Report for 2002, p 5
Smorogn Steel, Annual Report for 2001, p 5
BHP Steel, Annual Earnings Report, 30 June 2002, p 6

3 Extracted from http://www.industry.gov.au/content/controlfiles/display_details.cfm?ObjectID=99BC02FC-7257-4640-A9DB437A54CA729A 13.08.03
State of Australian Cities National Conference 2003
Table 3 shows the employment numbers in OneSteel and Smorgon in 2001 and 2002. The employment numbers from BlueScope Steel were not available in any annual report.

<table>
<thead>
<tr>
<th>Company</th>
<th>Employment 2001</th>
<th>Employment 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>OneSteel Limited</td>
<td>7,379</td>
<td>6,989</td>
</tr>
<tr>
<td>Smorgon Steel</td>
<td>5,975</td>
<td>7,914</td>
</tr>
</tbody>
</table>

Source: OneSteel, Annual Report for 2002, p 4-5 and p 52.4
Smorgon Steel, Annual Report for 2001, p 56

At the employment level, numbers in basic the iron and steel manufacturing had been drastically reduced (see Figure 2 below) as a result of restructuring and rationalising the industry in recent years to reduce cost and improve efficiency.

3.2 An Australian Steel Company: Company X
There are three steel companies in Australia. We concentrate the analysis of knowledge flows in company X because this company has a recent history of pursuing innovation and because its deep impact in the Hunter region. Company X was created by combining eight related businesses to form an integrated, innovative mining, steel manufacturing and steel and metal products distribution
company. Previously, these businesses were mainly organised as independent operations.

Company X is among the 4 percent of Australian manufacturing companies that use R&D. In the financial year of 2001 company X spent approximately $2.7 million on external R&D, primarily through various university based research and development activities. In the financial year 2002 company X had 243 research and development projects across its business: 50 percent of these represent new products, knowledge and process, 40 percent represents product enhancements and 10 percent represents process enhancement. (Company X Annual Report 2002: 8). Nine million were claimed under the R&D Tax Concession Program.

Company X is a manufacturer of steel long products and a distributor of metals. It manufactures and distributes anything from ‘structural, rail, rod, merchant bar, cold finish bar, chrome plated bar, reinforcing, wire, tube, pipes, fittings, valves and actuation’ It is also a distributor of sheet and coil, piping systems, plate and aluminium product. At Whyalla Steelworks in South Australia, company X processes iron ore from its mining operations into steel. The company has 200 operating locations (distributions and manufacturing facilities) throughout Australia and New Zealand. The three major manufacturing facilities are located in Newcastle and Rooty Hill in NSW, and Whyalla in South Australia. The bulk of company X’s products are used in the manufacturing, construction, mining, housing and agricultural industries.

Company X has divided its business into four business units. These are:

- Whyalla Steelworks;
- Market Mills;
- Distribution;
- Steel and Tube Holdings.

In this study we specifically looked at the Market Mills in Rooty Hill and Newcastle. In Sydney the Market Mills operates a steel mill and bar mill, and in Newcastle it operates a rod mill and bar mill.
Company X in Western Sydney (Rooty Hill)

Company X’s facilities in Greater Western Sydney\(^7\) are located at the 27 hectare site in the industrial area of Rooty Hill, and consists of the main process areas of scrap metal storage, cast shop and melt shop facilities, space for billet storage, dust and fume collection plant, warehouse, rolling mill and an administrative block. There are approximately 220 people working at the Rooty Hill Mill.

Every year over half a million tonnes of scrap metal is made into 500,000 tonnes of steel billets. 180,000 of these steel billets are manufactured on-site through the rolling mills, the remaining billets are transported to company X’s Newcastle Rod and Bar Mill. \(^8\)

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Company X in Newcastle

There are approximately 418 people working at the Newcastle Bar and Rod Mill.

The Bar Mill in Newcastle commenced in 1968, and it occupies a 30-hectare area in the industrial area of Mayfield. The bar mill comprises the main process areas of ‘reheat furnace, rolling mill, cutting and bundling equipment, purpose built round bar inspection facilities, as well as space for billet storage and warehouse’.\(^9\)

The mill manufactures approximately 360,000 tonnes of finished product per year.

Steel feed in billet form is transported from company X’s main steel making facility at Whyalla in South Australia and some from the Steel mill in Rooty Hill. In Newcastle they transform the billets into 360,000 tonnes of finished product. The mill’s reputation has been built on high quality engineering grade steels many of which are used in the Automotive Industries - steels like springs, tie rods, steering knuckles and transmission components. More than 218 people are employed at Newcastle Bar Mill.

The Rod Mill is also located in the industrial area of Mayfield and comprises the main process areas of a billet yard, reheat furnace, roughing mill, intermediate mill, pre-finishing mill, NO-TWIST finishing mill, coil handling system, coil

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\(^7\) Greater Western Sydney stretches from ‘the Blue Mountains in the west to the lower reaches of the Parramatta River in the east, and from the Wollondilly region in the south to the Hawkesbury River in the North’.\(^7\) Greater Western Sydney’s economy has from an historic point of view, been based on agriculture and manufacturing industries. It is the third largest regional economy after Sydney and Melbourne. The population is around 1.6 million, 43 percent of Sydney’s population.


despatch facility, as well as space for rod storage. The Newcastle rod mill produces around 600,000 tones of rod per year. This is distributed both for the Australian market and internationally. There are currently more than 200 people employed at the mill.

4. KNOWLEDGE FLOWS OF AN AUSTRALIAN STEEL COMPANY

Keith Smith (1999) developed a model to look at how knowledge flows at the firm level through the key areas in a company; the kind of techniques the company uses for these key activities; the knowledge base for each of the key activities; and the research institutions and associated partners for each of the key activities.

The following table shows some of the knowledge flows proposed by Smith (1999) to understand knowledge acquisition by traditional industries. The table reports on The Steel Mill Process, Rod Mill process, Bar Mill process, and Safety and Environmental Processes within company X in Newcastle and GWS.
Table 3: Company X Knowledge Flow in Newcastle (2003)

<table>
<thead>
<tr>
<th>Key Areas&quot;</th>
<th>Key Activities</th>
<th>Techniques</th>
<th>Field of specialisation</th>
<th>Research Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Rod Mill Process</td>
<td>Inspection</td>
<td>Decurrent Testing</td>
<td>Operators after company training</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Laser Farrage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>People Inspection</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Roller Production</td>
<td>Maintenance</td>
<td>Operators</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equipment / Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chemical and mechanical Testing</td>
<td>N/A</td>
<td>Engineering</td>
<td>University of Melbourne</td>
</tr>
<tr>
<td>2. Bar Mill Process</td>
<td>Inspection</td>
<td>Laser Farrage</td>
<td>Operators</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>People Inspection</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Roller Production</td>
<td>Maintenance</td>
<td>Operators</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equipment / Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chemical and mechanical Testing</td>
<td>N/A</td>
<td>Engineering</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Source: AEGIS interview data (2003)

Other areas include steel-making and environment protection.
Table 4: Company X Knowledge Flow in Rooty Hill (2003)

<table>
<thead>
<tr>
<th>Key Areas</th>
<th>Key Activities</th>
<th>Techniques</th>
<th>Field of specialisation</th>
<th>Research Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Steel Making Process</td>
<td>Melting and Recycling Scrap</td>
<td>Electric Arc Furnace</td>
<td>Electrical and mechanical engineering, metallurgy, various levels of trade and process workers.</td>
<td>UNSW (metallurgy)</td>
</tr>
<tr>
<td></td>
<td>Refining Recycled Metal</td>
<td>Laidel Furnace, Metallurgical techniques</td>
<td>Metallurgy, electrical and mechanical engineering, various levels of trade and process workers.</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Casting into billets</td>
<td>N/A</td>
<td>Metallurgy, mechanical and electrical engineering, and trade and process workers.</td>
<td>None</td>
</tr>
<tr>
<td>2. The Bar Mill Process</td>
<td>Reheat</td>
<td>N/A</td>
<td>Mechanical and electrical Engineering, Refractories</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Inspection</td>
<td>N/A</td>
<td>N/A</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Roller Production</td>
<td>Mechanical</td>
<td>Mechanical and electrical engineering</td>
<td>Two overseas companies.</td>
</tr>
<tr>
<td></td>
<td>Dispatch</td>
<td>N/A</td>
<td>Logistical supports, Engineering</td>
<td>None</td>
</tr>
<tr>
<td>3. Environmental Protection</td>
<td>Sound proof</td>
<td>N/A</td>
<td>N/A</td>
<td>A German company for the design of the sound proof building, engineers from BHP and private consultants (10 years ago)</td>
</tr>
<tr>
<td></td>
<td>Activities to reduce pollution</td>
<td>N/A</td>
<td>N/A</td>
<td>CSIRO</td>
</tr>
<tr>
<td>4. Safety</td>
<td>Awareness of safety issues</td>
<td>N/A</td>
<td>N/A</td>
<td>American Company, world leader in safety.</td>
</tr>
</tbody>
</table>

Source: AEGIS interview data (2003)

The findings from the tables above show the same trend that firms in high innovative sectors present: most knowledge is built in-house through on-the-job training, and when external partners are used other specialised companies are used as much as university departments (OECD, 2003).

Company X in the Hunter and Western Sydney Knowledge Systems

Company X as a whole has links with several research institutions across Australia; The University of Sydney, The University of Western Sydney, Victorian University of Technology, CRC for welded Structures, The University of Adelaide, Monash University, CIDECT as well as many other Australian research institutions. This close link with universities and research institutions helps the
company to redefine steel design and provide good design tools. However, specifically in GWS, Company X has links only with three out of the 23 organisations:

1. UWS: Centre for Construction Technology and Research (CCTR).
2. Australian Industry Group, as a council member.
3. TAFE: recruiting staff.

Company X interactions in the Hunter Region despite the longer tradition of the steel industry in Newcastle is only with five out of the 36 Hunter organisations:

1. Hunter Medical Research Institute: Company X gave corporate sponsorship
2. University of Newcastle:
   - The Centre for Infrastructure, Performance and Reliability;
   - Mathematical and Physical Sciences;
   - NewStat Industry;
   - Faculty of Health, School of Medical Practice and Population Health.
3. TAFE: staff recruitment
4. The Hunter Valley Research Foundation. Company X is one of the principals and a major sponsor.
5. Hunter Region Worldskills. Company X is one of the sponsors of this not-for-profit organisation developed to promote the standards and status of vocational training and job skills.

We further tested the informal/formal interactions of company X with the regional organisation in the Hunter and in the Greater Western Sydney. Our interview data shows very little interaction between company X and the regional innovation/knowledge systems. This is the same both for the Hunter and Greater Western Sydney. The perceptions within the steel company are of lack of knowledge of what the interaction with regional organisations could bring into the company development. See some of the comments below,

‘It is unlikely for us to go out to the universities at the moment. The pro-activity should come from the universities and the knowledge organisations’. (AEGIS, Interview data 24.09.03)

13 http://www.hmr.net.au/don-corp.htm
We would like to get some better understanding regarding what is available. We don’t necessarily know what the knowledge organisations can offer us and we do not always know what is available in the region. We would like the organisations to talk to us and find out what our needs are. (AEGIS, Interview data 24.09.03)

‘Most TAFE courses go from six months to four years. What we often are after is two day courses, short course in manufacturing. If they do have these kind of courses they do not advertise it’. (AEGIS, Interview data, 16.09.03)

‘I have a negative perception of academia. A lot of the time we are looking for solutions to a business problem, and I do not find these institutions suitable to provide strategic solutions’. (AEGIS, Interview data, 28.08.03)

In summary, our findings show that company X is not well integrated into the Knowledge Systems of the Hunter region and the Greater Western Sydney region. The situation is slightly better in the Hunter due to the heritage from BHP but the position of company X in the regional network has diminished if compared with the significantly more integrated position that BHP held back in 1999 where the company has links with 20 out of the 25 organisations (Martinez-Fernandez, 2001). The finding is significant as we know now that all elements of regional knowledge systems – universities, research labs, specialised business services and industry- are key ingredients in promoting both industry and regional growth (Martinez-Fernandez 2001, Acs 2002). A better integration in regional knowledge/innovation systems will them impact on internal industry growth.

5. CONCLUSIONS

Many studies in the last two decades have focused on the needs and opportunities available to new SMEs as if the demographics of the ‘new economy’ are more relevant to these largely ‘client-services oriented SMEs. Traditional industries have not been studied in the same way in regards to their fit within their regional innovation system and even less when the study concerns their knowledge flows and interactions with knowledge organisations in the region where they are located.

The study reported here focused on understanding some of the challenges of the Australian Steel industry to become more knowledge orientated and take advantage of the available knowledge and innovation systems in their geographical proximity.

Although the increasing globalisation effect facilitates access to information and sharing of knowledge everywhere, ‘geographical proximity’ is more relevant than
ever. Most knowledge is ‘sticky’ and the emphasis of ‘what is relevant to who’ is better transmitted face to face.

The results of our study indicate that most knowledge at company X is generated in-house and there are very limited interactions with organisations in their geographical location. Traditional industries seems to be getting most of their knowledge through technological knowledge embodied into machinery and equipment, movement of personnel, and cooperation with multinational suppliers as noted by one of the interviewees,

‘A lot of our knowledge is developed in house and a lot of our knowledge we get through employing people from other companies’ (AEGIS Interview Data).

There might be some informal links but not at the level of unit division. There are only two links to the 23 organisations in Western Sydney, and five to the 36 organisations in the Hunter region. The distribution business unit in Greater Western Sydney is the main interface of the two linkages and seems to be the most ‘service’ and client oriented.

Our findings indicate that within large organisations differences in how knowledge is generated, acquired, and adapted might be substantial and that one ‘business model’ will not apply to all business units. Previous studies recommending that business should concentrate on strategies for producing service-product packages (AEGIS, 2002) might not apply to large firms of traditional industries as the complexity of the business does not allow for a single strategy to take place.

More importantly the findings of the study found no strong evidences of company X interaction with the regional knowledge system in which they are located. A few more interactions were found in the Hunter region probably due to the strong footprint of BHP in the region but even then the links are very limited. The importance of these knowledge systems for innovation in firms and organisations have been acknowledged in many studies (OECD, 2001; OECD 2002, Maskell, 2002; Acs, 2002) but the importance of having traditional industries integrated in regional systems affects not only the innovation of the particular firm or the related industry cluster but also of the other actors in the region, especially public research institutions. As the Australian Industry Group (AIG, 2002) study notes regarding manufacturing businesses, there is a need to ‘encourage greater collaboration between industry and public R&D facilities. Only 24 percent of firms undertaking R&D did so in collaboration with a university, CSIRO
and a CRC. More needs to be done to encourage public funded R&D institutions to expand their industry outreach programs’ (AIG, 2002:12).

The growing trend among new regional universities of encouraging ‘university-industry engagement’ (Sproats, 2003; Martinez-Fernandez & Leevers, 2003; B-HERT, 2003) can only be good for strengthening regional learning and increasing their capability for continuous innovation. Thus, the lessons from this study affect traditional industries, higher education institutions and other public-private-civic organisations alike. At the policy level much more is needed to stimulate and grow regional networks that involve all the actors in a knowledge system.

The role of these networks in the city-region is then seen as linked to innovation and growth. The findings in this paper are relevant for both the strategic development of traditional industries and for the development of regional policy as they provide support for the transformation of traditional industries into more knowledge-oriented models. Based on the findings we offer two recommendations:

1. That traditional industries develop specific activities targeting interactions with institutions and organizations within their region;
2. That policy-makers give more attention to specific policies and programs supporting linkages of public/semipublic institutions and NGOs with traditional industries at the local/regional level.
REFERENCES


The Hunter Valley Research Foundation, (2002), Knowledge Intensive Manufacturing in the Hunter Region, HunterNet Co-operative Ltd and The NSW Department of State and Regional Development,

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SYDNEY, 2003

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For all enquiries, please contact:-

University of Western Sydney
Urban Frontiers Program
Building 22, Campbelltown Campus
Locked Bag 1797, Penrith South DC  NSW  1797

Phone +61 2 4620 3443
Fax +61 2 4620 3447

Email urbanfrontiers@uws.edu.au
Web www.urbanfrontiers.uws.edu.au